Docket No. 4074

SPECIFICATION

TITLE: METHOD AND APPARATUS FOR ALERTING CIVILIAN MOTORISTS TO THE APPROACH OF EMERGENCY VEHICLES

Priority of United States Provisional Application Serial No. 60/422,144, filed October 29, 2002, is hereby claimed.

The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Public Law 96-517 (U.S.C. 202) in which the Contractor has elected to retain title.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is to a method and apparatus for alerting civilian motorists to the approach of emergency vehicles and more particularly relates to an in-vehicle indicator aimed at increasing civilian motorists awareness and response time to approaching emergency vehicles.

2. Background Information

Numerous in-car distractions and/or technology innovations have reduced the effectiveness of emergency vehicle sirens. Specifically, in-car stereo systems and advances in "air-type, noise-reduction" vehicles have limited motorists awareness of their outside environment. Even the loudest emergency vehicle sirens and horns have limited affect. For that reason, there is a need for in-vehicle alert systems or indicators that warn a



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civilian motorist of the approach of emergency vehicles that will warn them of approaching emergency vehicles in the area in addition to the audio alert of sirens.

It is therefore one object of the present invention to provide an in-vehicle alert system to alert civilian motorists to approaching emergency vehicles.

Yet another object of the present invention is to provide an in-vehicle indicator in the form of a dash-based visual indicator as a complementary feature to an audio warning system.

Still another object of the present invention is to provide an in-vehicle dash-based visual indicator for civilian motorists in the form of a small, identifiable indicator in the field of vision of the normal dashboard display.

Still another object of the present invention is to provide an in-vehicle indicator that warns civilian motorists of approaching emergency vehicles that during normal, non-preemptive behavior would not be visible.

Yet another object of the present invention is to provide an in-vehicle indicator to alert civilian motorists to approaching emergency vehicles that includes an icon that blinks during preemptive behavior and displays the approximate direction from which an emergency vehicle is approaching.

BRIEF DESCRIPTION OF THE INVENTION

The purpose of the present invention is technology aimed at reducing emergency vehicle traffic-related accidents. The

invention is also aimed at increasing civilian motorists awareness and response time to approaching emergency vehicles.

There is a current need for a combination of new warning approaches when emergency vehicles are in a particular area. As a result, it has been determined that the current need is a combination of two new warning approaches:

1. Noise reduction, verbal instructions;
    a) Reduction of distracting internal vehicle radio noise,
    b) Audio alerts, preemptive car radios identifying and locating emergency vehicles.
2. Visual in-car indicator;
    a) Dash-based indicator,
    b) Display that provides a visual indication of the location of an emergency vehicle.

Under current Intelligent Transportation System (ITS) standards, new car RDS (Radio Data System) compliant radios allow sub-carrier interrupt for traffic reports, news, weather and paging. RDS compliant radios allow proprietary applications to transmit data to a vehicle over FM radio stations. New technology developed for ERDS (Emergency Radio Data System) a subset of RDS will be used specifically for emergency proximity alerts. Using RDS a motorist's radio will detect a new report (e.g., automatic traffic reports at selected intervals) and immediately switch to the corresponding station just as a report

is started. Using this same sub-carrier interrupt process, a system has been designed whereby emergency vehicles can eliminate or reduce the volume of all compliant car radios within a short radius around the emergency vehicle. As an emergency vehicle comes within range (i.e., approximately 300 feet), a transmitter on the emergency vehicle (e.g., a fire truck) transmits a broadcast interrupt signal on pre-selected audio and data sub-carrier frequencies. Using the same 57 KHz sub-carrier interrupt signal emergency vehicles can eliminate/reduce the volume of all RDS compliant vehicle radios within a short radius around the emergency vehicle.

An emergency vehicle will send out burst transmissions on all vehicle radio frequencies, that individually include the sub-carrier RDS signal. These transmissions are short enough and have a large enough duty cycle and period to prevent major interference on peripheral (>300 feet) vehicle radios. They are strong enough to insure nearby (<300 feet) vehicles receive a clear RDS sub-carrier interrupt. This requires a 20ms pulse on each frequency every three to five seconds. The power level is dynamically determined by the emergency vehicle using a scanning receiver (computes each frequency output based on current radio station input levels in the area). A motorist's vehicle radio, upon receiving the correct application code interrupt, can then activate either audio or visual alerts within the vehicle. It is only necessary to interrupt the radio every five to seven

seconds since built-in latency timing will insure the system has hysteresis. In other words, if an emergency vehicle interrupted a motorist's radio within the last three seconds, it is safe to say that the emergency vehicle is still in the area and the car should maintain the interrupt for a short while longer.

This frequency is set aside for emergency notifications, and will also have direct verbal instructions on the approaching emergency vehicle position and type. For instances, the signal might be: "Caution: Fire truck approaching from behind. Please slow down and pull over." This information is composed in the motorist's vehicle using a local GPS sensor and remote GPS positioning of the emergency vehicle (transmitted via RDS or ERDS). Motorists may have the option to enable or disable this feature on their radio, for example when they are in areas where they are unlikely to encounter any emergency vehicles, however it would be expected that they would enable this feature most of the time as it only serves to increase their safety.

In addition to the audio alert, a dash-based visual indicator has also been designed, as a complementary (yet not dependent) feature to the audio warnings. This indicator addresses other potential distractions such as cell phones. The visual and audio warning systems are preferably independent. The systems complement each other, but are not mutually dependent. For example, the in-dash visual indicator will work even if the radio is not on. The flashing indicator will alert

a motorist to turn on the radio to receive emergency information.

Both the emergency vehicle and the civilian motorist's vehicle will have on-board diagnostic computers (OBDs) as well as a global positioning system transceiver. The global positioning system (GPS) transceivers will be standard transceivers readily available. The emergency vehicle will have a EVI master controller providing an output to a EVI transmitter that transmits EVI sub-carrier frequency (data) to the civilian motorist's radio/receiver. The EVI transmitter will also have a primary frequency for transmitting audio to the motorist's radio/receiver.

The civilian motorist's vehicle will also have a global positioning system transceiver providing an output to an on-board computer which in turn provides an output to an EVI slave controller. The slave controller provides data-coded instructions to the motorist's radio/receiver and receives emergency vehicle data. This emergency vehicle data is transmitted to an in-dash indicator that is designed to indicate the approach of an emergency vehicle as well as the direction from which the vehicle is approaching.

The on-board emergency vehicle diagnostic computer provides speed, acceleration, and other pertinent vehicle data in digital form. It incorporates the information or data from the global positioning system into the data stream. This data is

transmitted by the EVI master controller to the EVI transmitter which transmits a EVI primary frequency for audio and a sub-carrier frequency for data to the civilian motorist's radio receiver.

An EVI slave controller receives output from an on-board diagnostic computer in the civilian motorist's vehicle that receives emergency vehicle data via an ITS compliant radio, compares it to the local vehicle, and information from the GPS transceiver and drives the in-dash indicator that is the "data coded instruction" back to the ITS radio.

The civilian motorist's radio/receiver produced under current ITS standards allows sub-carrier interrupts for traffic reports, news, and weather as well as other emergency information. The civilian motorist's radio has the capability to be automatically and remotely switched from the normal radio station (tape or disk) operation to an "emergency frequency" by the presence of a sub-carrier from the EVI transmitter on the emergency vehicle. The sub-carrier source is used to carry the digital emergency vehicle data to the civilian motorist's radio receiver and activate audio instructions in addition to volume reduction as well as providing input to control and in-dash indicator. Thus the emergency vehicle primary channel (EVI primary frequency) delivers an audio warning to a motorists such as emergency vehicle approaching. This would alert the civilian motorist to listen for the siren and will also indicate a

particularly direction of approach.

The EVI transmitter transmits on a pre-selected audio and data sub-carrier frequency. This causes the motorist's radio/receiver to be interrupted and switched to an assigned station. This frequency, set aside for emergency notifications, will have direct instructions on the emergency vehicle position and type. For instance, "Caution: Fire truck approaching from behind. Please slow down and pull over."

The above and other objects, advantages, and novel features of the invention will be more fully understood from the following detailed description and the accompanying drawings, in which:

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram illustrating the visual/audio hardware configuration for transmitting alert to a civilian motorist.

Figure 2 is a diagram illustrating the configuration of a car relative to an approaching emergency vehicle for receiving position information transmitted from the emergency vehicle.

Figure 3 illustrates an in-dash indicator to alert a civilian motorist to an approaching emergency vehicle.

## DETAILED DESCRIPTION OF THE INVENTION

A method and apparatus for indicating and alerting civilian motorists to approaching emergency vehicles is illustrated in the block diagram of Figure 1. The system includes a civilian

motorist's radio 10 that is constructed according to current ITS compliant standards. That is, radio 10 is a new design under the standards that allows automatic sub-carrier interrupts for traffic reports, news, weather and emergencies. Thus, radio 10 not only receives normal AM and FM broadcasts but also can be automatically and remotely interrupted to receive emergency transmissions.

The civilian motorist's radio 10 is connected to a slave controller 12 which in turn receives data and information from on-board diagnostic computer (OBD) 14. Data to on-board computer 14 is provided from a global positioning system transceiver 16.

Likewise, emergency vehicles will be equipped with a global positioning system transceiver 18 providing an output to an on-board emergency vehicle computer 20. On-board emergency vehicle computer 20 provides information such as speed, acceleration and other pertinent vehicle data in digital form to EVI master controller 22. The output from the emergency vehicle OBD 20 and EVI master controller is transmitted from EVI transmitter 24 to the civilian motorist's radio and receiver 10. Audio alerts from approaching emergency vehicles are provided from civilian motorist's radio/receiver 10 to speakers 26 as will be described in greater detail hereinafter.

In addition to the audio alerts provided through speakers 20, a visual in-vehicle indicator 28 is provided which also will

be described in greater detail hereinafter.

If a system is enabled, which in most cases it will be automatic, a motorist's radio 10 will receive and detect input from an emergency vehicle transmitter 24. This input will come from the on-board diagnostic computer 20 in the emergency vehicle receiving input from global positioning system 18 and providing an output to EVI master controller 22 about position, acceleration and other pertinent vehicle data in digital form. EVI master controller 22 accepts digital data from OBD 20 and generates a data stream from EVI transmitter 24 to provide audio output on an EVI primary frequency and data output on an EVI sub-carrier frequency. The EVI sub-carrier frequency from EVI transmitter 24 immediately switches civilian motorist's radio 10 to the corresponding emergency frequency on receipt of an output from the emergency vehicle. The sub-carrier defined by ITS standards provides an output designed to eliminate or reduce the volume of all compliant civilian car radios 10 within a short radius around an emergency vehicle.

As an emergency vehicle comes within range, OBD computer 20 and EVI master controller 22 provide data to EVI transmitter which is transmitted to civilian motorist's radio 10 to switch output to the emergency frequency. EVI transmitter 24 will then transmit pre-selected audio as well as data on sub-carrier frequencies. The frequency set aside by ITS standards for emergency notifications will direct instructions on emergency

vehicle position and type to the civilian motorist's radio 10. For example, information such as "Caution: Fire truck approaching from behind. Please slow down and pull over" or other suitable audio information which will be heard by the motorist over speakers 26.

In addition to the audio alert, an in-dash visual indicator 28 is activated. Dash-based visual indicator 28 is complimentary (yet not dependent) feature that is in addition to the audio warning system output from speakers 26. That is, dash-based visual indicator will be activated even if radio 10 is off and will alert a motorist to turn on his radio. Dash-based visual indicator 28 will be placed in control panel 30 of a motorist's vehicle as illustrated in Figure 2. A typical motorist's dashboard having radio 10 and speakers 26 is illustrated. For purposes of this invention, speakers 26 are illustrated as in the dashboard although they would be placed in any suitable convenient location in a vehicle.

Preferably, dash-based visual indicator 28 is placed in a convenient position on control panel 30 where it is easily visible by the driver. In this case, it is illustrated as behind but not blocked by steering wheel 32. Dash-based visual indicator 28 can also address other potential distractions such as cell phones. Although a specific design for the visual indicator dash-based visual indicator 28 is presented, the design content is intended for any type of visual indicator

(including future customizable LCD dash-based displays). Also a "heads up display" (HUD) similar to that used in aircraft is feasible.

The important feature here is the placement of a small, yet quickly identifiable indicator, within the field of vision of a driver that can be quickly and rapidly identified. Preferably during normal, non-preemptive behavior, dash-based visual indicator 28 is not visible. This feature is much like the indicators on control panel 30 such as "engine or oil lights" that are only illuminated when there is a problem. Additionally there may be different, very bright color lights than the normal lights on a control panel 30 of a vehicle so they instantly alert a driver. EVI slave controller 12 in a motorist's vehicle receives emergency vehicle data from EVI transmitter 24 through radio 10, compares it to local vehicle data received from the motorist's OBD computer 14 and drives dash-board visual indicator 28.

Another optional but preferred feature would be to strobe these visual signals so they will quickly be brought to the attention of the driver. In the preferred embodiment, the display would include a central illuminated display having the letters "EV" 36 blinking to indicate the approach of an emergency vehicle. Surrounding this central EV display 36 would be a series of dots 38 that would provide an indication of the approach and direction of an emergency vehicle. Each dot 38 on

the dash-based visual indicator 28 indicates a particular direction of approach of an emergency vehicle. Beginning at the 12 o'clock or upper position, the first dot 40 would indicate for example an emergency vehicle approaching dead ahead. Looking at the illuminated dots in a clockwise direction, the dots would indicate an emergency vehicle approaching ahead right 41, with subsequent dots indicating right 42, rear right 38, and behind 43. Subsequent dots from the behind dot 43 would indicate rear left 44, left 45, and ahead left 46, and back again to 12:00 position 40 which is straight ahead. That is, dash-based visual indicator 28 would have bright, blinking or strobed lights around a central illuminating light having an EV 36 that indicate various positions. These lights 40 through 46 indicate the various positions from straight ahead at the 12 o'clock position to ahead right, right, rear right, rear, rear left, left, and ahead left, respectively. Strobing the dots and 38 and 40 through 46 such as with a photo flash type light would be a much better attention getter and would instantly notify the driver of an approaching emergency vehicle.

The configuration of a civilian motorist's vehicle relative to an emergency vehicle is illustrated in Figure 3. Position information would be transmitted from emergency vehicle 48 to civilian motorist's vehicle 50. The civilian motorist's radio 10 receives a stream of data from EVI transmitter 24 switching radio 10 to receive an audio alert over speakers 26.

Simultaneously, dash-based visual indicator 28 would illuminate with a pulsing light showing the letters "EV" 36 to indicate the approach of emergency vehicle. Also, strobe lights 38 and 40 through 46 would be appropriately illuminated to indicate the approximate direction of approach of emergency vehicle 48. As stated previously, for example, illumination of strobe light 38 indicates an emergency vehicle approaching from the rear and to the right.

Thus there has been disclosed a novel and unique in-vehicle warning system to alert drivers of approaching emergency vehicles. This system would provide an audio warning to a driver and simultaneously eliminate or reduce the volume of ITS compliant in-car radios within a short radius around an emergency vehicle. Simultaneously, a dash-based visual indicator would be illuminated indicating the approximate direction and approach of emergency vehicle. Strobed, highly-visible lights in the display would blink or flash alerting the driver of an approaching emergency vehicle. This method and apparatus would overcome the problems of in-car distractions that reduces the effectiveness of sirens.

This invention is not to be limited by the embodiment shown in the drawings and described in the description which is given by way of example and not of limitation, but only in accordance with the scope of the appended claims.